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PHASE 2

GEO-ENVIRONMENTAL REPORT

job number	C3900/24/E/5910
date	04.07.2024
site address	York House, 198 Barnsley Road, Denby Dale, West Yorkshire, HD8 8TS
written by	S. Hale
checked by	R. Palmer
issued by	S. Hale

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Report on a Phase 2 Geo-environmental Investigation

Location:	York House 198 Barnsley Road, Denby Dale, West Yorkshire, HD8 8TS
For:	Techwill Limited
Report No.	C3900/23/E/5910 Report date: July 2024

For and on behalf of **Rogers Geotechnical Services Ltd**

Steven Hale BSc FGS Geo-environmental Technician	**Rob Palmer** MSc FGS ACIEH Engineering Director

Report Summary[1]

Item	Comments	Section
Development	Demolition of existing industrial unit and the construction of 3 No. new residential dwellings with associated gardens and car parking.	1.
Geology	Solid geology – Pennine Lower Coal Measures Formation.	5.
Strata Conditions	Capping of made ground overlying weathered Pennine Lower Coal Measures Formation.	6.
Groundwater	None encountered during investigation.	6.2
Foundation Design	Shallow foundation solution.	10.1
Effect of Sulphates	DC-1 concrete.	10.5
Contamination	Site is uncontaminated.	11.

[1] This summary should not be relied upon to provide a comprehensive review. All of the information contained in this document should be considered.

1. Introduction

It is understood that the land at York House is to be developed by the demolition of the existing industrial unit and the construction of 3 No. new residential dwellings with associated gardens and car parking. Consequently, a site investigation has been undertaken in accordance with the instruction from the client. This work was required in order to determine the nature of the underlying soils, to assess their engineering properties and to assist in the design of safe and economical foundations for the proposed development. This investigation also takes into consideration the risk of any contamination present. This report describes the work undertaken, presents the data obtained and discusses the ground conditions in relation to the proposed works.

2. Limitations

The recommendations made and opinions expressed in this report are based on the ground conditions revealed by the site works, together with an assessment of the site and of the laboratory test results. Whilst opinions may be expressed relating to sub-soil conditions in parts of the site not investigated, for example between borehole positions, these are for guidance only and no liability can be accepted for their accuracy.

This report has been prepared in accordance with our understanding of current best practice. However, new information or legislation, or changes to best practice may necessitate revision of the report after the date of issue.

3. Desk Study

A Phase 1 Desk Study has been undertaken by Rogers Geotechnical Services (RGS) and the results were presented as report number C3900/23/E/5909 in June 2024. This report has been used extensively during the current intrusive investigation.

4. Fieldworks

The fieldworks were undertaken on the 5th June 2024 and included four windowless sample boreholes with standard penetration tests (SPTs) at regular intervals at all positions.

The investigatory locations are shown on the site plan which is presented in Appendix 1 to this report.

4.1 Windowless Sample Boreholes

The boreholes were sunk using a drive-in windowless sampler. The cores were undertaken in 1m lengths and reduced in diameter from 87mm for the first 1m through to 77mm for subsequent 1m increments. The recovered cores were sealed and returned to the laboratory for logging and subsequent testing. The soils were described in general accordance with BS5930: 2015 +A1: 2020 and full descriptions are given on the windowless sample records which are presented in Appendix 2. Also included on these records are the core diameters and percentages of core recovered.

4.2 Standard Penetration Tests

Standard penetration tests (SPT) were undertaken at regular depth increments within the windowless sample boreholes. The SPT was conducted in accordance with the procedures given in BS EN ISO 22476: Part 3: 2005 +A1: 2011, and the results are summarised on the borehole record. During this work an automatic trip hammer of 63.5kg falling through 750mm was employed to drive either a cone or split barrel sampler assembly into the ground and the recovered barrel samples were retained in air tight plastic containers.

5. Geology

The available published geological data for the site has been examined and the following table presents the anticipated geology.

Table 1: Geological Data for the Site

Strata Type	Strata Name[2]	Previous Name[3]	Description[3]
Superficial Geology	N/A	N/A	Not indicated to underlie the site.
Solid Geology	Pennine Lower Coal Measures Formation	Lower Coal Measures Formation	Interbedded grey mudstone, siltstone and pale grey sandstone, commonly with mudstones containing marine fossils in the lower part, and more numerous and thicker coal seams in the upper part.

[2] Sources: British Geological Survey (NERC) Map Sheet 86; Glossop; Solid and Drift Edition, and Geology of Britain Viewer [*online resource from www.bgs.ac.uk*]
[3] Sources: British Geological Survey (NERC) Lexicon of Named Rock Units [*online resource from www.bgs.ac.uk*]

6. Strata Conditions

In accordance with the geology of the area, the succession has been shown to include the following:

Table 2: Generalised Strata Profile

Depth m below ground level to underside of layer	**Strata Type**	**Positions Encountered**	**Groundwater Strikes** m below ground level
0.05	MADE GROUND (Black, bituminous material)	WS01 & WS02	None
0.15 – 0.40	MADE GROUND (Dark grey, silty, slightly sandy, GRAVEL)	WS01, WS03 & WS04	None
0.45	MADE GROUND (Firm, brown, slightly sandy, slightly gravelly, silty CLAY)	WS02	None
0.45 – 2.10	WEATHERED PENNINE LOWER COAL MEASURES FORMATION (Firm becoming stiff, orangish brown mottled grey and brown, slightly sandy, slightly gravelly, silty CLAY)	WS01, WS03 & WS04	None
1.40	WEATHERED PENNINE LOWER COAL MEASURES FORMATION (Dense, orangish brown and grey, clayey, silty, slightly gravelly SAND)	WS02	None
+1.38	WEATHERED PENNINE LOWER COAL MEASURES FORMATION Dense becoming dense, clayey, silty, slightly sandy GRAVEL)	WS03	None
+1.45 – +2.15	PENNINE LOWER COAL MEASURES FORMATION (Orangish brown and brown SANDSTONE recovered as gravel)	WS01, WS02 & WS04	None

'+' denotes that the strata extended below the termination depth of the investigated positions, thus the extent of the deposit is only proven to the depths indicated

6.1 General Strata

The borehole records indicate that made ground of both cohesive and granular material is present at all locations to depths of between 0.15m and 0.45m below ground level (begl). Beneath this made ground, cohesive and granular materials anticipated to be representative of completely weathered fractions of the underlying Pennine Lower Coal Measures Formation were present. These soils were recorded at all positions at depths of between 1.38m and 2.10m begl. It was noted that underlying these weathered soils within WS01, WS02 and WS04, sandstone was found to be present at depths of between 1.45m and 2.15m begl. It is thought that this rock is the beginning of the undifferentiated strata of the underlying Pennine Lower Coal Measures Formation i.e. solid geology.

6.2 Groundwater

No groundwater strikes were observed during the site investigation. However, it should be appreciated that the normal rate of boring does not permit the recording of an equilibrium water level for any one strike, moreover, groundwater levels are subject to seasonal variation or changes on local drainage conditions.

7. Insitu Testing

7.1 Standard Penetration Tests

The standard penetration tests carried out are summarised in the following table:

Table 3: Summary of Standard Penetration Tests

Location	Strata	Depth Range (m)	SPT 'N' (Blows/300mm)		Comments
			Granular soils	Cohesive soils	
WS01	Slightly sandy, slightly gravelly, silty CLAY	1.00m to 1.45m	–	29	SPT's indicate a stiff in-situ condition
WS02	Clayey, silty, slightly gravelly SAND		53	-	SPT's indicate a dense in-situ condition
WS03	Clayey, silty, slightly sandy GRAVEL		54	-	SPT's indicate a dense in-situ condition
WS04	Slightly sandy, slightly gravelly, silty CLAY		-	51	SPT's indicate a very stiff in-situ condition

8. Laboratory Testing - Geotechnical

The following programme of laboratory testing has been undertaken on samples obtained during this investigation:

- Determination of water content — BS EN ISO 17892-1:2014
- Determination of liquid and plastic limits — BS EN ISO 17892-12:2018
- Determination of particle size distribution (Dry) — BS EN ISO 17892-4:2016: 5.2
- Determination of particle size distribution (Wet) — BS EN ISO 17892-4:2016: 5.2
- Sedimentation by pipette — BS EN ISO 17892-4:2016: 5.3 – 5.4
- Soluble sulphate content — BS 1377-3:2018+A1:2021: Pt3: 7.3
- pH value — BS 1377-3:2018+A1:2021: Pt3: 12

The test results are presented in Appendix 3 and are summarised below:

Table 4: Summary of Geotechnical Test Results

Test type	Number of tests	Range of results		Comments
Water content determinations	5	13% to 23%		
Index properties (4 Point)	4	LL PL PI	29% to 52% 19% to 23%% 10% to 29%	Clay of low to high plasticity. Consistency index 0.7 to 1.5 NHBC Class – Negligible to Medium
Particle size distribution (Wet sieve and sedimentation)	1	Gravel Sand Silt Clay	35% 41% 15% 09%	Clayey silty gravelly SAND Uniformity coefficient – 112.9 Curvature coefficient – 119.9
Soluble sulphate & pH	4	SO_4 pH	0.03 to 0.15 g/l 7.2 to 7.4	

In cohesive soil the approximate cohesion, c_u, and coefficient of consolidation, m_v, may be obtained from the equivalent SPT 'N' value using the following expressions (Stroud 1975).

$c_u = f_1 N$

$m_v = \frac{1}{f_2 N}$

where:

c = cohesion (kN/m^2).
m_v = Coefficient of consolidation (m^2/MN).
f_1 & f_2 = factors based on plasticity index.
N = SPT 'N_{300}' value.

For the cohesive soils revealed at this site the highest (worst case) plasticity index[4] of 29% could be employed, which suggests an f_1 value of 4.7 and an f_2 value of 0.47.

8.1 Geotechnical Properties

The idealised geotechnical properties employed in design are summarised below.

Table 5: Summary of Geotechnical Properties

Property	Range of values		Comments
Volume change potential (NHBC)	Low to high		
Shear strength parameters (at proposed foundation level)	c_u	135kN/m^2	Stroud (1974) where $c_u = f_1 N$ and triaxial compression test results. Assuming an N of 29.
Consolidation characteristics	m_v	0.073m^2/MN	Stroud (1974) where $m_v = 1/f_2 N$. Assuming an N of 29.
Concrete classification	DC1		Natural ground locations (Static water)

9. Laboratory Testing - Environmental

A suite of testing was conducted on samples from across the site and the following regime was undertaken.

- Metals – Cd, Cr^{VI}, Cu, Hg, Ni, Pb, V and Zn.
- Semi and Non-Metals - As, Se, Free CN^- and Phenols.
- Polycyclic aromatic hydrocarbons (PAHs).
- Petroleum hydrocarbons (TPHs).
- Others – pH, organic content and total/soluble SO_4^{2-}.
- Asbestos.

This testing was undertaken by i2 Analytical Ltd and the results of all of the chemical testing are presented in Appendix 3 of this report.

[4] See paragraph 6.2 'Index Property Tests'

10. Discussion of Ground Conditions - Geotechnical

It is understood that the site is to be developed by the demolition of the existing industrial unit and the construction of 3 No. new residential dwellings with associated garden areas and car parking. At the time of writing this report the precise layout and method of construction is not known, thus the discussion below is of a generalised nature.

It cannot be recommended that foundations be constructed directly within the made ground at the near surface. It should be appreciated that while competent soils were also found at near surface, these soils are variable between cohesive and granular fractions of the weathered Pennine Lower Coal Measures Formation across the site. However, it is considered that the foundations could be placed on shallow or spread foundations placed within these soils

10.1 Foundations

The results of this investigation indicate that clays, comprising firm becoming stiff, slightly sandy, slightly gravelly, silty clay, will be revealed from depths ranging between 0.40m and 2.15m begl within the areas of boreholes WS01 and WS04. Additionally, dense granular soils consisting of sand and gravel were uncovered at borehole positions WS02 and WS03 respectively.

It is considered that these soils will provide a suitable bearing stratum, provided that the foundations are placed within soil generally described as being present in a firm or dense insitu condition. It is considered that strip or spread foundations constructed within this material, at a minimum depth of say 1.00m, could be designed assuming an allowable increase in stress given in the following table:

Table 6: Allowable Increase in Stress

Foundation Type		**Strip Footings**			**Spread Footings**		
Foundation Breadth	B (m)	0.6	1.0	1.5	0.6	1.0	2.0
Foundation Depth	D (m)	1.00			1.00		
Allowable increase in stress	(kN/m²)	>250			>250		

The allowable increase in stress given above assumes a factor of safety of 3 against general shear failure, with cohesion of 135kN/m^2 at the foundation depths using the most onerous SPT ‘N’ value of 29. It should be appreciated that it is generally accepted that a cohesion of at least 40kN/m² should be sought for a traditional footing, as this is widely regarded as being the lowest limit for a ‘firm’ cohesive soil. Given the proposed development, the footings are to be gradually loaded during the construction of the property walls and floors i.e. they shall not be instantaneously loaded. As such, shear failure beneath the footings are unlikely. Given the type of structures proposed, settlements at the above loading intensities are estimated to remain within tolerable limits provided that the underlying soils are carefully inspected immediately once final trimming has taken place.

10.2 General Comments for Excavations

The stability of excavation faces cannot be guaranteed thus temporary support to the excavation faces may become necessary unless the foundations are constructed using trench-fill techniques. In this method the foundation trenches should be excavated, inspected and backfilled with concrete as a continuous operation. Under no circumstances should operatives be allowed to enter unsupported excavations.

Should the excavations be required to stand open, it is considered that a blinding layer of lean-mixed concrete be placed over the sub-grade. This expedient will reduce loosening or softening of the underling soil due to both physical disturbance and the ingress of surface water.

Should seepage of groundwater be encountered it is considered that it could be dealt with using a simple form of de-watering. Such a system could include the excavation of sumps from which the water could be pumped.

10.3 Ground-floors

In light of the made ground encountered across the site to depths of up to 0.45m, it will be necessary to either compact this material in order to install a ground bearing floor slab or install a suspended floor slab design.

In the case of the suspended design, the floor slab would be suspended between foundation positions, such that the floor loads are transmitted via the foundations to competent soils at depth. However, this could be costly for such a large design as the proposed sports hall.

Compaction of the made ground in preparation for a ground bearing floor slab would fashion such made ground into a more competent material capable of supporting such a slab without significant variation in bearing capacity. In this case this may be the more cost-effective option.

Further to the above, due to the volume change potential at the site, should the floor be placed within the zone of influence of any existing, or proposed, trees and shrubs, an allowance for soil volume change should be included. Further guidance is available in the NHBC standards; however, soil volume change can typically be catered for by providing a suitable void or utilise proprietary materials beneath the floor slab.

10.4 Hard-standing Areas

It is considered that any hard-standing at the site could be constructed employing traditional pavement design. A design California Bearing Ratio (CBR) of 3% could be employed in the pavement design[5]. However, it is recommended that proof rolling of the sub-grade be undertaken to establish the suitability of the soils, to expose any soft or weak ground and to ensure the sub-grade is well compacted prior to construction. Any areas of soft or weak ground should be remediated by increasing the sub-base thickness. Alternatively, weak material could be locally removed and replaced with a compacted granular capping layer. If construction were to be undertaken during the winter or after periods of prolonged rainfall, it may be prudent to employ a geotextile and/or a geogrid between the sub-base and sub-grade.

[5] Table 11.1, *Reproduction of TRRL Report LR1132 (1984)*, Smith (2006), Smith's Elements of Soil Mechanics, 8th ed.

10.5 Effect of Sulphates

In view of the nature of the underlying soils it is considered that the design sulphate class be assessed with reference to Table C2[6], which is provided in BRE Special Digest 1, *Concrete in aggressive ground*: Part C. On the basis of this table and considering the soluble sulphate contents recorded, it can be shown that well compacted buried concrete should be designed in accordance with Class DS-1 requirements. Assuming static groundwater, the table also indicates that the aggressive chemical environment for concrete (ACEC) classification is AC-1s.

In order to evaluate the design chemical (DC) class for the buried concrete at this site reference should be made to Table D1[7], which can be found in Part D, *Specifying concrete for general cast-in-situ use,* of BRE Special Digest 1. From this table it may be shown that for an intended working life of at least 50 years the concrete design class DC-1 is required.

11. Discussion of Ground Conditions - Environmental

11.1 Discussion of Test Results

It is understood that the site is to be developed by the demolition of the existing industrial unit and the construction of 3 No. new residential dwellings with associated garden areas and car parking. Consequently, the site may be classified as residential with plant uptake.

11.1.1 Soil Samples

The results of the chemical testing undertaken on soil samples obtained during this investigation have been compared to the ATRISK soil screening values (SSVs) as compiled by WS Atkins plc. With respect to the results it should be appreciated that the soil organic matter (SOM) content for the samples tested was found to range between 0.3% and 0.5%. On this basis, it is considered that the screening values associated with 1% SOM should be adopted. These values have been derived in such a way as to adhere to the principles within the revised CLEA model and include the most current release of the SGVs. A list of subscribers is provided within the website[8] and these include many local authorities.

A comparison of the results of the testing, together with the data given above, can be found within Appendix 4. These results indicate the following:

Table 7: Summary of Contaminated Areas

Location	Depth (m)	Contaminants found to be exceeding SSVs (Residential with plant uptake)
WS01	0.75	PAHs: Benzo(g,h,i)perylene
WS02	0.50	PAHs: Chrysene, Benzo(b)fluoranthene, Indeno(1,2,3-c,d)Pyrene, Dibenz(a,h)Anthracene & Benzo(g,h,i)perylene
WS04	0.50	PAHs: Indeno(1,2,3-c,d)Pyrene & Benzo(g,h,i)perylene

[6] Table C2, *Aggressive Chemical Environment for Concrete (ACEC) classification for brownfield locations*
[7] Table D1, *Selection of the DC Class and the number of APMs for concrete elements where the hydraulic gradient due to groundwater is 5 or less: for general in-situ use of concrete.*
[8] http://www.atrisksoil.co.uk/pages/general/subscribers.asp

Concentrations of cadmium, chromium^{VI}, mercury, selenium, free cyanide, phenols (total) and total petroleum hydrocarbons (aliphatic C5 to C35; aromatic C5 to C35) were below the detection limits for the tests. Detectable levels of all other contaminants were recorded, but these fell below the associated Atrisk Soil Screening Values. In addition, no asbestos was detected within the soils samples tested.

It should be appreciated that the soil screening values for PAHs and TPHs (where appropriate) represents vapour saturation limits. The inhalation of vapour pathway contributes less than 10% of total exposure, which is unlikely to significantly affect the combined assessment criterion[9]. In view of this, the ATRISK soil SSVs notes that the users may wish to consider using a combined assessment criterion if free product is not observed, the values for which are also provided on the summary of contamination analysis. It is therefore considered that the criteria for no free product should be adopted for the PAHs and TPHs at this site. The results of the contaminants found to exceed these screening values are tabulated below:

Table 8: Summary of Areas Contaminated by PAHs & TPHs

Location	Depth (m)	Contaminants found to be exceeding SSVs (Residential with Plant Uptake)
WS01	0.75	None
WS02	0.50	None
WS04	0.50	None

On the basis of the above information, the results of the investigation have concluded that the site is generally uncontaminated with respect to the proposed end use.

11.2 Site Specific Risk Assessment

11.2.1 Approach

The presence of contamination hazards and the risks associated with them should be assessed in accordance with industry practice and the 'suitable for use' approach. This has been conducted with reference to The Department for Environment, Food and Rural Affairs (DEFRA) and The Environment Agency[10] advice on the assessment of risks arising from the presence of contamination in soils and using the source-pathway-receptor approach.[11] This method dictates that there must be a risk of contaminant produced at a 'source' in sufficient concentration to cause harm and there must be a 'pathway' for the contaminant to reach an identifiable 'receptor' for the linkage to be proved and a contamination hazard to be considered present. Not all substances are contaminants and not all contaminants are considered to be a risk. Indeed DEFRA and The Environment Agency state that 'a contaminant is a substance which has the potential to cause harm, while a risk itself is considered to exist if such a substance is present in sufficient concentration to cause harm and a pathway exists for a receptor to be exposed to the substance.'[12]

[9] Ref: ATRISK soil, SSVs derived using CLEA v1.071 for 1% SOM, Residential with plant uptake land use, 23.06.17.
[10] R&D Publication CLR 8, 'Assessment of Risks to Human Health from Land Contamination: An overview of the Development of Soil Guideline Values and Related Research'.
[11] The pollution linkage approach was developed by 'Circular 2/2000 Contaminated Land: Implementation of Part II of The Environmental Protection Act 1990' which provides meanings for the terms contained in The Environmental Protection Act 1990 Part IIA, the primary legislation for addressing the issues of contaminated land.
[12] See 'Circular 2/2000 Contaminated Land: Implementation of Part II of The Environmental Protection Act 1990', appendix A.

11.2.2 Conceptual Ground Model and Risk Assessment

In view of the results of the chemical testing undertaken the conceptual site model is presented accordingly as Table 9.

The preliminary risk assessment has been evaluated with reference to the following ratings and definitions:

N/A - A source-pathway-receptor linkage is not considered to exist and therefore a risk assessment is not required.

Low - A pollution linkage is unlikely and/or the likelihood of harm occurring is low and of minor consequence.

Moderate - The linkage exists but the likelihood of harm occurring is not considered to be significant although remedial action may be necessary

High - The linkage exists and the available data indicates that significant harm may be caused and remedial action could be necessary.

The results of the risk assessment are presented in Table 9.

Table 9: Conceptual Site Model and Site-Specific Risk Assessment				
Conceptual Site Model			**Site Specific Risk Assessment**	
Pathways	**Receptor**	**Linkage Present?**	**Risk Rating**	**Notes**
Direct contact/dermal absorption/soil ingestion	Operative	No – no contamination found to be present at the site.	N/A	No further action required.
	End User			
	Neighbours			
Inhalation of Dust/Vapours	Operative	No – no contamination found to be present at the site.	N/A	No further action required.
	End User			
	Neighbours			
Ingestion of fruit/vegetables and/or waters	Operative	No – no contamination found to be present at the site.	N/A	No further action required.
	End User			
	Neighbours			
Migration of hazardous gases via permeable strata or shallow mining activity	Operative	No – no sources of gas noted during investigation and no credible sources noted within the surrounding area during the desk study.	N/A	No further action required.
	End User			
	Neighbours			

Spillage/loss/run off direct to receiving water	Controlled Waters	No – no contamination found to be present at the site.	N/A	No further action required.
Migration via permeable unsaturated strata	Controlled Waters			
Run off via drainage/sewers etc	Controlled Waters			
Direct contact with contaminated soils	Plants	No – no contamination found to be present at the site.	N/A	No further action required.
Uptake via root system				
Direct contact with contaminated soils	Building Materials	Yes – elevated levels of PAHs revealed at the site may represent a risk to building materials or plastic water pipes. Moreover, testing indicates that the aggressive chemical environment for concrete classification is AC-1s.	Low (plastic services) Low (buried concrete)	Please see section 11.3.3 for information on good building practice. It is likely that the made ground shall be removed during the site preparation works.
Direct contact with contaminated groundwater				
Exposure to Radon	Operative	No – Not in a radon affected area.	N/A	Less than 1% of properties are above the action level. No radon protection measures required.
	End User			
UXO Risk	Operative	No – it is considered that the activities of the end users are unlikely to affect any UXO devices that may be present below the site.	Low	
	End User			

11.3 Indicative Remediation Strategy

In view of the site-specific risk assessment it is considered that it will not be necessary to undertake any specific remediation at this site. It should be appreciated, however, that careful inspection of the subgrade should be made during the groundworks. Should areas of contamination be detected then further testing may become necessary.

11.3.1 General Approach to Construction

In order to fulfil the objectives defined above it is likely that the following remedial strategy could be utilised. It is recommended that a pragmatic approach be undertaken, with observational techniques being employed at each stage of the work.

Ground-works

During the ground-works phase of the development, protection to the site operatives is required. The risk to site operatives is considered under the Health and Safety at Work Act 1974, together with regulations made under the act, which includes the Control of Substances Hazardous to Health (COSHH) regulations. Therefore, the risks to site personnel must be considered under the Construction Design and Management (CDM) regulations at the planning stage and be included in the contractor's Health and Safety Plan and site specific Method Statements. These documents should include the following main elements.

- Site operatives at all levels should be made aware of the fundamental principles of identifying potentially contaminated soils and the hazards of working with such soils not identified by the ground investigation.
- Personal hygiene facilities, including washing and messing, must be provided and site operatives encouraged to use them.
- Where work is undertaken in dry weather the site should be dampened down to avoid dust. In addition, dust masks must be provided to all site operatives for use at all times.
- Where vehicles are transferring soil to landfill site they should be covered to prevent any potential contamination of the surrounding area by dust.
- Any stockpiles of soil should be sheeted over to prevent excessive amounts of airborne dust.
- Where work is undertaken in wet weather, vehicle and wheel washing facilities are required to ensure that the vehicles leaving the site do not transfer any potential contamination to surrounding areas.

On completion of the ground-works a careful site inspection of the sub-grade would be required. Should visual or olfactory evidence of contamination be revealed then further testing may become necessary.

Construction

During the construction phase of the development the following items are required to protect the structure from the potential contaminants revealed at this site.

- Beneath, pavements and hard-standings clean inert granular sub-base should be employed.
- For buried concrete the results of the sulphate and pH testing indicate that the design sulphate class for the site should be DS-1.

11.4 Fill Materials

It should also be appreciated that any fill material, either site-won or imported, to be employed at the site should be subjected to the following assessment to determine its suitability.

Fill materials should be initially screened, by a suitably qualified engineer to establish that:

- It is a suitable growing media if it is to be employed as such, including compliance with BS3882 (2015).
- It is free from obvious contamination i.e. visual or olfactory evidence.
- It has not come from areas where Japanese Knotweed or other invasive or injurious plants are suspected to be growing.
- It is not a statutory nuisance, such as being odorous.
- It is free from unsuitable material i.e. whole bricks, brick ties, timber or glass.

It should also be appreciated that any fill should be subjected to validation testing to assess its suitability. The following table has been taken from YALPAG[13] documentation and may be used as a guide. Depending on the origin and nature of the material, not all fill will require the sampling frequency and testing indicated, although this should be in agreement with any regulatory bodies (such as the Local Authority).

Table 10: Validation Sampling and Testing

Fill Type	Frequency	Minimum Determinands
Virgin Quarried Material	1 or 2 depending on the type of stone (to confirm the inert nature of the material)	Standard metals/metalloids (As, Cd, Cr, Cr(VI), Cu, Hg, Ni, Pb, Se, Zn)
Crushed Hardcore, Stone, Brick	Minimum 1 per 1000m³	Standard metals/metalloids as above plus PAH (16 USEPA) and Asbestos
Greenfield/ Manufactured Soils	The greater of a minimum of 3 or 1 per 250m³	Standard metals/metalloids as above plus PAH (16 USEPA) and Asbestos
Brownfield/ Screened Soils	The greater of a minimum of 6 or 1 per 100m³	Standard metals/metalloids as above plus PAH (16 USEPA), TPH (CWG banded) and Asbestos Any additional analysis dependant on the history of the donor site.

The screening values for the above regime should also be agreed with any regulatory bodies; however, the following is recommended in the first instance.

Table 11: Fill Screening Values

Contaminant	Screening Value (Residential with Plant Uptake) (mg/kg)				Reference
	1% SOM		6% SOM		
As	37		37		Atrisk^{SOIL} SSVs
Cd	22.1		22.1		Atrisk^{SOIL} SSVs
Cr(VI)	3.62	20.5	3.62	20.5	Atrisk^{SOIL} SSVs
Cu	4730		4790		Atrisk^{SOIL} SSVs
Hg	8.81		15.80		Atrisk^{SOIL} SSVs
Ni	136		136		Atrisk^{SOIL} SSVs
Pb	200		200		Atrisk^{SOIL} SSVs
V	136		138		Atrisk^{SOIL} SSVs
Zn	20000		20300		Atrisk^{SOIL} SSVs
TPH CWG	See attached summary sheet within Appendix 5				Atrisk^{SOIL} SSVs
PAH 16 USEPA	See attached summary sheet within Appendix 5				Atrisk^{SOIL} SSVs

Please see summary sheet within Appendix 5 for full screening values including PAHs & TPHs.

[13] *YALPAG Technical Guidance for Developers, Landowners and Consultants – Verification Requirements for Cover Systems V11.2* Appendix 1a, June 2020.

The above screening values should be considered with respect to the Soil Organic Matter (SOM) of the subject material i.e. 1% SOM would be typical for granular fill and 6% SOM for topsoil. Testing should comply with UKAS and MCERTS, where applicable, and undertaken by an accredited laboratory.

Where the material has been derived from a commercial company, certificates or other industry quality protocol compliance i.e. WRAP should be obtained. However, it will be necessary to ensure that this documentation specifically related to the material being imported, it is no more than two months old and complies with the screening and frequency requirements given above.

Suitable fill materials should be either placed immediately or sufficiently quarantined to prevent cross-contamination. If it is necessary, the quarantined material should be placed on appropriate sheeting and covered to prevent it becoming mixed with contaminated soils or dust, or penetrated by mobile contaminants.

11.5 Verification Report

It is not anticipated that it will be necessary to produce a verification report for submission to any statutory authorities. However, should any fill be imported to site it may be necessary to produce a report characterising the suitability of the clean material. Such a report would in including the derivation of the material, comments from a visual screen, the tests results of chemical screening, delivery tickets where appropriate and the conditions by which the clean material has been stored and handled on site.

The report detailed above should be produced by a suitably qualified engineer. The number of verification areas for the development should be confirmed with any statutory authorities for the site.

12. Recommendations for Further Work

- This report should be forwarded to the relevant authorities as soon as practicable to ensure they have sufficient time to review and discuss any issues.
- Discussions with ground work contractors in relation to the requirement for testing of materials to be disposed off-site (Waste Acceptance Criteria) and the suitability of imported materials.
- Detailed design of the sub-structure.

Clearly Rogers Geotechnical Services Ltd would be happy to offer advice with respect to the above and assist where necessary.

13. References

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  - Geology of Britain Viewer: (*http://maps.bgs.ac.uk/geologyviewer_google/googleviewer.html)*
  - Lexicon of Named Rock Units:
  - (*http://www.bgs.ac.uk/lexicon/)*

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- Building Research Establishment (BRE) Special Digest 1 (2005), Third Edition: Concrete in aggressive ground, BRE Press, Garston.
  - Part C: *Assessing the aggressive chemical environment.*
  - Part D: *Specifying concrete for general cast-in-situ use.*

- Department for Environment, Food and Rural Affairs and the Environment Agency (2009) DEFRA Science Report – Final SC050021/SR2, *Human Health toxicological assessment of contaminants in soil*. Environment Agency, Bristol.

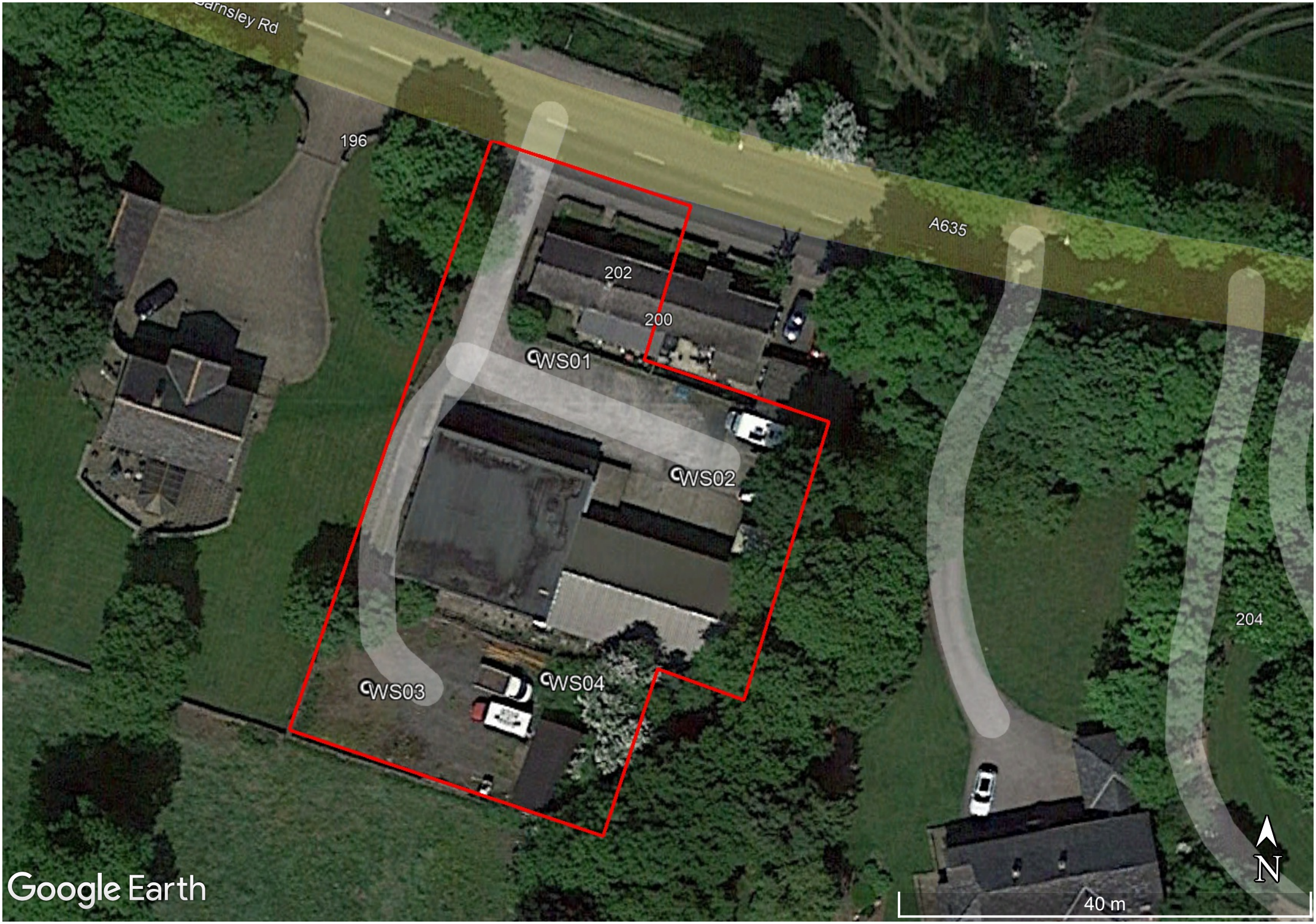
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- Department for Environment, Food and Rural Affairs (2014) SP1010: *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document*.

- Wilson S, Oliver S, Mallet H, Hutchings H, Card G, *Assessing risks posed by ground gasses to buildings,* CIRIA Report C665.

Appendix 1

Site Plan


arnsley Rd
196
A635
202
200
WS01
WS02
WS03
WS04
204
N
40 m
Google Earth

Appendix 2

Borehole Records

Borehole Log

Environmental Geotechnical Specialists

Borehole No. **WS01**

Sheet 1 of 1

Project Name: York House	Project No. C3900/24/E/5910	Co-ords:	Hole Type WLS
Location: 198 Barnsley Road, Denby Dale, West Yorkshire, HD8 8TS		Level:	Scale 1:25
Client: Techwell Limited		Dates: 05/06/2024	Logged By SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
							0.05			MADE GROUND (Black, bituminous material).
				87	100		0.40			MADE GROUND (Dark grey, silty, slightly sandy, angular to sub-angular and fine to coarse GRAVEL of ash, brick, clinker, concrete and sandstone. Sand is fine to coarse).
		0.90	D							Firm becoming stiff, orangish brown mottled grey, slightly sandy, slightly gravelly, silty CLAY. Sand is fine. Gravel is sub-angular and fine to coarse of sandstone. [WEATHERED PENNINE LOWER COAL MEASURES FORMATION]
		1.00	SPT			N=29 (5,7/7,6,7,9)				
		1.50	D	77	100					
		1.90	D							
		2.00	SPT			0 (31,50/0 for 0mm)				
							2.10			Orangish brown SANDSTONE recovered as gravel. [PENNINE LOWER COAL MEASURES FORMATION]
							2.15			End of Borehole at 2.15m

1 2 3 4 5

Remarks

AGS

Borehole Log

Environmental Geotechnical Specialists

Borehole No. **WS02**

Sheet 1 of 1

Project Name: York House	Project No. C3900/24/E/5910	Co-ords:	Hole Type WLS
Location: 198 Barnsley Road, Denby Dale, West Yorkshire, HD8 8TS		Level:	Scale 1:25
Client: Techwell Limited		Dates: 05/06/2024	Logged By SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
							0.05			MADE GROUND (Black, bituminous material).
		0.50 - 1.00	B	87	100		0.45			MADE GROUND (Firm, brown, slightly sandy, slightly gravelly, silty CLAY. Sand is fine to coarse. Gravel is sub-angular and fine to coarse of ash, clinker, concrete and sandstone).
		0.90 1.00	D SPT			N=53 (5,7/8,8,14,23)				Dense, orangish brown and grey, clayey, silty, slightly gravelly, fine to medium SAND. Gravel is sub-angular and fine to coarse of sandstone. [WEATHERED PENNINE LOWER COAL MEASURES FORMATION]
							1.40 1.45			Brown SANDSTONE recovered as gravel. [PENNINE LOWER COAL MEASURES FORMATION]
										End of Borehole at 1.45m

1 2 3 4 5

Remarks

AGS

Borehole Log

Environmental Geotechnical Specialists

Borehole No. **WS03**

Sheet 1 of 1

Project Name: York House	Project No. C3900/24/E/5910	Co-ords:	Hole Type WLS
Location: 198 Barnsley Road, Denby Dale, West Yorkshire, HD8 8TS		Level:	Scale 1:25
Client: Techwell Limited		Dates: 05/06/2024	Logged By SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
							0.15			MADE GROUND (Dark grey, slightly sandy, angular to sub-angular and fine to coarse GRAVEL of brick, concrete and sandstone).
		0.30	D	87	100		0.45			Firm ,brown, slightly sandy, slightly gravelly, silty CLAY. Sand is fine. Gravel is sub-angular and fine to coarse of sandstone. [WEATHERED PENNINE LOWER COAL MEASURES FORMATION]
		0.90	D							Dense, clayey, silty, slightly sandy, sub-angular and fine to coarse GRAVEL of sandstone. Sand is fine to coarse. [WEATHERED PENNINE LOWER COAL MEASURES FORMATION]
		1.00	SPT			54 (11,12/14,19,21,)				
							1.38			End of Borehole at 1.38m

1 2 3 4 5

Remarks

AGS

Borehole Log

Environmental Geotechnical Specialists

Borehole No. **WS04**

Sheet 1 of 1

Project Name: York House	Project No. C3900/24/E/5910	Co-ords:	Hole Type WLS
Location: 198 Barnsley Road, Denby Dale, West Yorkshire, HD8 8TS		Level:	Scale 1:25
Client: Techwell Limited		Dates: 05/06/2024	Logged By SH

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Dia. (mm)	TCR (%)	Results	Depth (m)	Level (m)	Legend	Stratum Description
							0.30			MADE GROUND (Dark grey, slightly sandy, angular to sub-angular and fine to coarse GRAVEL of ash, brick, clinker, concrete and sandstone. Sand is fine to coarse).
		0.50	D	87	100					Firm becoming stiff, brown, slightly sandy, slightly gravelly, silty CLAY. Sand is fine to coarse. Gravel is sub-angular and fine to coarse of sandstone. [WEATHERED PENNINE LOWER COAL MEASURES FORNMATION]
		0.90	D							
		1.00	SPT			N=51 (9,10/10,14,14,13)				
							1.40			Brown SANDSTONE recovered as gravel. [PENNINE LOWER COAL MEASURES FORNMATION]
							1.45			End of Borehole at 1.45m

1 2 3 4 5

Remarks

AGS

Appendix 3

Laboratory Testing

Environmental
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Specialists

LABORATORY REPORT

job number	C3900/24/E/5910
date	04.07.2024
site address	York House, 198 Barnsley Road, Denby Dale, West Yorkshire, HD8 8TS
date scheduled	S. Hale
date issued	R. Palmer
issued by	S. Hale

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Offices 1 & 2 Barncliffe Business Park, Near Bank, Shelley, Huddersfield, HD8 8LU
01484 604354 Company No. 5130864

8948

Schedule of UKAS Accredited Laboratory Tests

1. CLASSIFICATION OF SOIL	BS 1377-2:1990	BS EN ISO 17892	Accredited (A)	Unaccredited (U)
1.1 Moisture / Water content determination				
i. Oven drying	Pt 2 : 3.2	Pt 1 : 2014 Pt 12 : 2018 : 5.3 / 5.5	A	
ii. Saturation m/c of chalk	Pt 2 : 3.3			U
1.2 Index Properties				
i. Liquid limit – cone penetrometer	Pt 2 : 4.3		A	
ii. Plastic limit	Pt 2 : 5.3		A	
iii. Shrinkage limit	Pt 2 : 6.3			U
iv. Linear shrinkage	Pt 2 : 6.5		A	
1.3 Particle Density				
i. Gas jar	Pt 2 : 8.2		A	
ii. Large pyknometer	Pt 2 : 8.3			U
iii. Small pyknometer	Pt 2 : 8.4	Pt 3 : 2015 : 5.1		U
1.4 Density Tests				
i. Linear measurement	Pt 2 : 7.2	Pt 2 : 2014 : 5.1	A	
ii. Immersion in water	Pt 2 : 7.3	Pt 2 : 2014 : 5.2		U
iii. Fluid / Water displacement	Pt 2 : 7.4	Pt 2 : 2014 : 5.3		U
iv. Sand replacement	Pt 9 : 2.1, 2.2			U
v. Core cutter	Pt 9 : 2.4			U
1.5 Particle Size Distribution				
i. Dry Sieve	Pt 2 : 9.2	Pt 4 : 2016 : 5.2	A	
ii. Wet Sieve	Pt 2 : 9.3	Pt 4 : 2016 : 5.2	A	
iii. Sedimentation by pipette	Pt 2 : 9.4	Pt 4 : 2016 : 5.3 / 5.4	A	
iv. Sedimentation by hydrometer	Pt 2 : 9.5			U
2. CHEMICAL TESTS	**BS 1377-3:2018**			
ii. Mass loss on ignition	Pt 3 : 4			U
3. COMPACTION RELATED TESTS	**BS 1377-4:1990**			
3.1 Dry density/moisture relationship				
i. 2.5kg rammer – 1 litre mould	Pt 4 : 3		A	
- CBR mould	Pt 4 : 3		A	
ii. 4.5kg rammer – 1 litre mould	Pt 4 : 3		A	
- CBR mould	Pt 4 : 3		A	
3.2 Moisture Condition Value				
i. Single point test	Pt 4 : 5.4			U
ii. MCV/moisture content relationship	Pt 4 : 5.5			U
3.3 California Bearing Ratio				
i. Undisturbed sample	Pt 5 : 7		A	
ii. Recompacted sample	Pt 5 : 7		A	
iii. Soaked, inc measurement of swell	Pt 5 : 7		A	
4. COMPRESSIBILITY OF SOIL	**BS 1377-5:1990**			
i. One dimensional consolidation	Pt 5 : 3		A	
ii. Swelling pressure test	Pt 5 : 3			U
5. SHEAR STRENGTH OF SOIL	**BS 1377-7:1990**			
i. Hand shear vane	Makers instructions			U
ii. Shear box (100mm square sample)	BS 1377 : Pt 7 : 4			U
iii. Triaxial – quick undrained	BS 1377 : Pt 7 : 8, 9		A	
6. PERMEABILITY				
i. Falling head	K. H. Head Vol 2			U
ii. Constant head	BS 1377 : Pt 6 : 6			U
iii Triaxial cell	BS 1377 : Pt 6 : 6			U
7. ROCK TESTS				
7.1 Classification Tests				
i. Natural moisture content	-			U
ii. Saturated moisture content	-			U
iii. Natural density	-			U
iv. Porosity	-			U
7.2 Strength Tests				
i. Point load index	ISRM '85			U
ii. Uniaxial compression test	ISRM '81			U

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Disclaimer

The results reported herein relate only to the material supplied to the laboratory.

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GEOTECHNICAL TESTING RESULTS

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Summary of Classification Test Results

Project No.	Project Name
C3900/24/E/5910	York House

Hole No.	Sample				Soil Description	Density bulk Mg/m³	Density dry Mg/m³	*w* %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m³	1pt/4pt	Date	Increase/Decrease
	Ref	Top	Base	Type												
WS01	1	0.90		D	Firm becoming stiff, orangish brown mottled grey, slightly sandy, slightly gravelly, silty CLAY.			23	97	30	20	10		4pt	13-Jun	Increase
WS01	3	1.90		D	Firm becoming stiff, orangish brown mottled grey, slightly sandy, slightly gravelly, clayey SILT.			17	68	29	NP			4pt	13-Jun	Increase
WS02	1	0.50	1.00	B	Medium dense, orangish brown and grey, clayey, silty, slightly gravelly, fine to medium SAND.			17							13-Jun	
WS03	1	0.30		D	Firm ,brown, slightly sandy, slightly gravelly, silty CLAY.			13	49	31	19	12		4pt	13-Jun	Increase
WS04	1	0.50		D	Firm becoming stiff, brown, slightly sandy, slightly gravelly, silty CLAY.			21	90	52	23	29		4pt	13-Jun	Increase

All tests performed in accordance with BS1377-2:2022 and BS EN ISO 17892 Part 1 A1 2022 unless specified otherwise
All Liquid Limit Tests performed on a 80g/30 Degree Cone unless specified otherwise

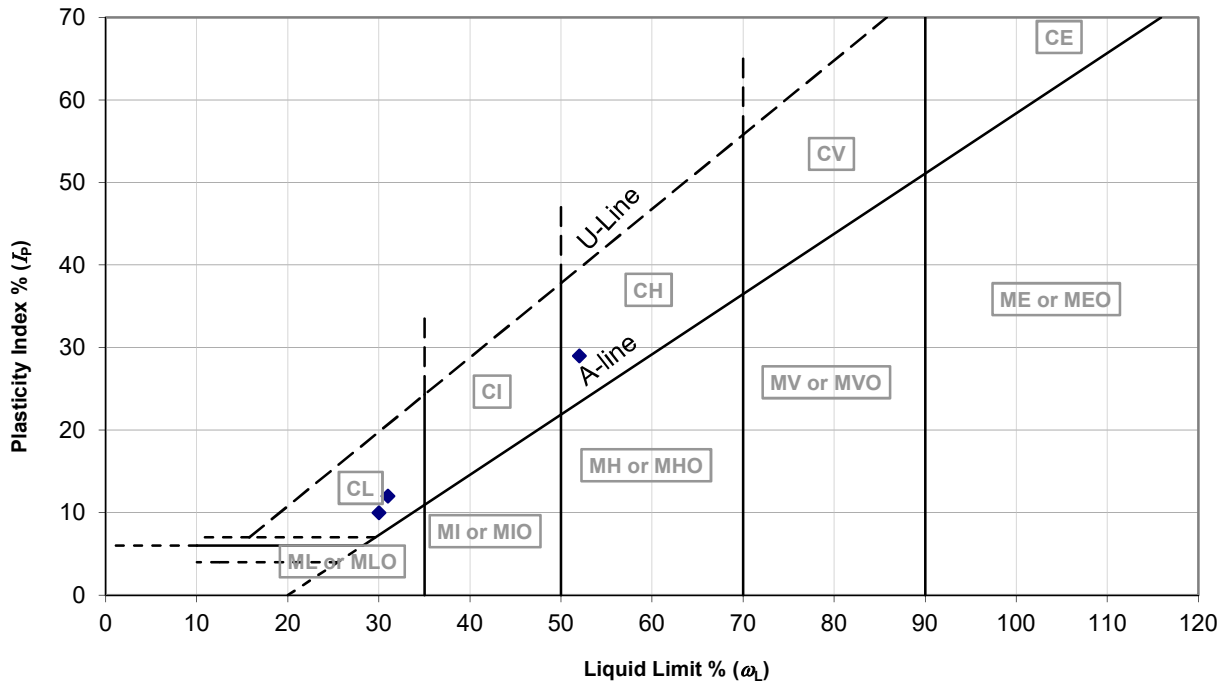
Key

Density test	Liquid Limit	Particle density
Linear measurement unless :	4pt cone unless :	sp - small pyknometer
wd - water displacement	cas - Casagrande method	gj - gas jar
wi - immersion in water	1pt - single point test	

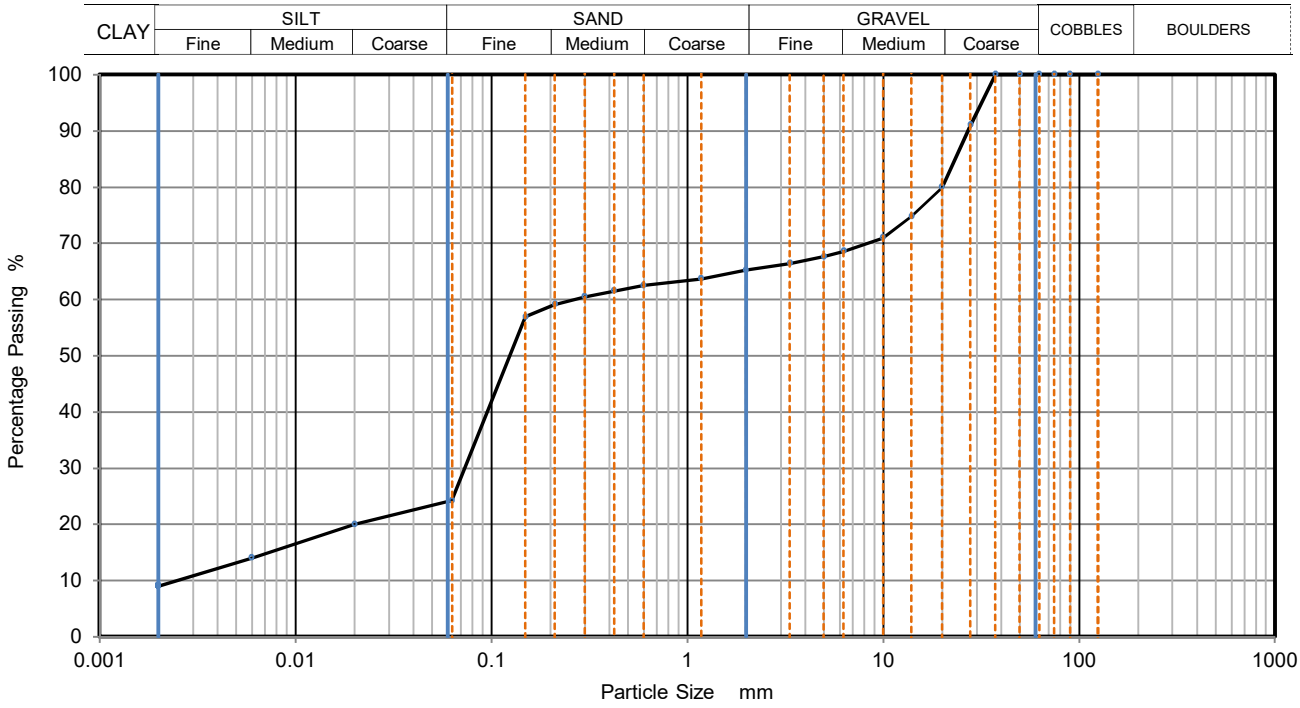
Date Printed	Approved By	Table
28/06/2024	Harry	1
		sheet 1

Rogers Geotechnical Services Ltd. Offices 1&2, Barncliffe Business Park, Near Bank, Shelley, Huddersfield, HD8 8LU	**Classification of Index Properties**	**C3900/24/E/5910**
Project Name: York House	**BS EN ISO: 17892: Parts 1, 12**	Fig. 2 / Sheet. 1
Location: Denby Dale		Input By: Harry
Client: Techwell Limited		Check By: Harry

Location	Depth (m)	Water Content (ω) (%)	Liquid Limit (ω_L) (%)	Plastic Limit (ω_P) (%)	Plasticity Index (I_P) (%)	Retained by 0.425mm (%)	Modified (ω) (ω') (%)	Modified (I_P) (I_P') (%)	Liquidity/ Consistency (I_L) (%)	Liquidity/ Consistency (I_C) (%)	Casagrande Class	N.H.B.C Class (%)
WS01	0.90	23	30	20	10	3	24	10	0.3	0.7	C L	*
WS01	1.90	17	29	NP		32	25					
WS03	0.30	13	31	19	12	51	27	6	-0.5	1.5	C L	*
WS04	0.50	21	52	23	29	10	23	26	-0.1	1.1	C H	MEDIUM



RGS	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**C3900/24/E/5910**
				Borehole/Pit No.	WS02
Site Name	York House			Sample No.	1
Soil Description	Medium dense, orangish brown and grey, clayey, silty, slightly gravelly, fine to medium SAND.			Depth, m	0.50
Specimen Reference	4	Specimen Depth	0.5 m	Sample Type	B
Test Method	ISO 17892 -4, by sieving and pipette sedimentation			KeyLAB ID	WS02_PSD1



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0201	20
90	100	0.0060	14
75	100	0.0020	9
63	100		
50	100		
37.5	100		
28	91		
20	80		
14	75		
10	71		
6.3	69		
5	68		
3.35	66		
2	65		
1.18	64		
0.6	63	Particle density (assumed)	
0.425	62	2.65	Mg/m3
0.3	61		
0.212	59		
0.15	57		
0.063	24		

Dry Mass of sample, g: 2488

Sample Proportions	% dry mass
Very coarse	0
Gravel	35
Sand	41
Silt	15
Clay	9

Grading Analysis		
D_{100}	mm	37.5
D_{60}	mm	0.263
D_{30}	mm	0.0735
D_{10}	mm	0.00233

Remarks

Preparation and testing in accordance with BS EN ISO 17892 - 4, unless noted below

Test performance date: 14/06/2024

Operator	Checked	Approved	Sheet printed	Fig 3
EC	Harry	Harry	28/06/2024	Sheet 1

Summary of Geotechnical Chemical Test Results

Project No.	Project Name
C3900/24/E/5910	York House

Hole No.	Sample				Soil Description	Org	LOI	pH	Sulphate as SO_4			Chloride, Cl		CO_2	TDS	<2mm	Remarks
	Ref	Top	Base	Type					Total acid sol.	2:1 water :soil	ground water	water sol.	acid sol.				
						%	%		%	g/l	g/l	%	%	%	mg/l	%	
WS01	2	1.50		D	Firm becoming stiff, orangish brown mottled grey, slightly sandy, slightly gravelly, silty CLAY.			7.29		0.03						71	
WS02	2	0.90		D	Medium dense, orangish brown and grey, clayey, silty, slightly gravelly, fine to medium SAND.			7.44		0.05						62	
WS03	2	0.90		D	Medium dense becoming dense, clayey, silty, slightly sandy, sub-angular and fine to coarse GRAVEL of sandstone.			7.16		0.15						46	
WS04	2	0.90		D	Firm becoming stiff, brown, slightly sandy, slightly gravelly, silty CLAY.			7.27		0.04						58	

Key

Tests performed in accordance with BS 1377 unless annotated otherwise

Org	Organic matter content	Cl	Chloride content
LOI	Mass loss on ignition at 440°C	CO_2	Carbonate content (rapid titration)
		TDS	Total Dissolved Solids

Date Printed	Approved By	Table
28/06/2024	HJL	4
		sheet 1

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Analytical Report Number : 24-025278

Project / Site name:	York House	**Samples received on:**	14/06/2024
Your job number:	C3900	**Samples instructed on/ Analysis started on:**	14/06/2024
Your order number:		**Analysis completed by:**	21/06/2024
Report Issue Number:	1	**Report issued on:**	21/06/2024
Samples Analysed:	3 soil samples		

Signed: Izabela Wójcik

Izabela Wójcik
Senior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

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The results included within the report are representative of the samples submitted for analysis.

Analytical Report Number: 24-025278
Project / Site name: York House

Lab Sample Number				228704	228705	228706
Sample Reference				WS01	WS02	WS04
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.75	0.50	0.50
Date Sampled				13/06/2024	13/06/2024	13/06/2024
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	15	13	11
Total mass of sample received	kg	0.1	NONE	0.8	0.8	0.8
Asbestos						
Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	WEM	WEM	WEM
General Inorganics						
pH (L099)	pH Units	N/A	MCERTS	7.6	8.2	8
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Total Sulphate as SO_4	%	0.005	MCERTS	0.008	0.014	0.011
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	25	47	34
Water Soluble SO_4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	12.5	23.6	16.8
Organic Matter (automated)	%	0.1	MCERTS	0.5	0.3	0.5
Total Phenols						
Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Speciated PAHs						
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	0.21	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	0.17	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.08	1.3	0.06
Anthracene	mg/kg	0.05	MCERTS	< 0.05	0.25	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.16	2.2	0.15
Pyrene	mg/kg	0.05	MCERTS	0.14	2.3	0.14
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.07	0.96	0.07
Chrysene	mg/kg	0.05	MCERTS	0.08	1.1	0.08
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	0.1	1.3	0.12
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	< 0.05	0.63	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.09	1.3	0.11
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.06	0.68	0.07
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	0.17	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.07	0.75	0.09
Total PAH						
Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	0.84	13.5	0.88

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Analytical Report Number: 24-025278
Project / Site name: York House

Lab Sample Number				228704	228705	228706
Sample Reference				WS01	WS02	WS04
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.75	0.50	0.50
Date Sampled				13/06/2024	13/06/2024	13/06/2024
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**			
Heavy Metals / Metalloids						
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	5.1	8.1	6.9
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	15	23	26
Copper (aqua regia extractable)	mg/kg	1	MCERTS	7	13	21
Lead (aqua regia extractable)	mg/kg	1	MCERTS	7.5	11	31
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	17	25	31
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	21	26	27
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	33	55	85
Petroleum Hydrocarbons						
TPHCWG - Aliphatic >EC5 - EC6 $_{HS_1D_AL}$	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >EC6 - EC8 $_{HS_1D_AL}$	mg/kg	0.02	NONE	< 0.020	< 0.020	< 0.020
TPHCWG - Aliphatic >EC8 - EC10 $_{HS_1D_AL}$	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050
TPHCWG - Aliphatic >EC10 - EC12 $_{EH_CU_1D_AL}$	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
TPHCWG - Aliphatic >EC12 - EC16 $_{EH_CU_1D_AL}$	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0
TPHCWG - Aliphatic >EC16 - EC21 $_{EH_CU_1D_AL}$	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0
TPHCWG - Aliphatic >EC21 - EC35 $_{EH_CU_1D_AL}$	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0
TPHCWG - Aliphatic >EC5 - EC35 $_{EH_CU+HS_1D_AL}$	mg/kg	10	NONE	< 10	< 10	< 10
TPHCWG - Aromatic >EC5 - EC7 $_{HS_1D_AR}$	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC7 - EC8 $_{HS_1D_AR}$	mg/kg	0.01	NONE	< 0.010	< 0.010	< 0.010
TPHCWG - Aromatic >EC8 - EC10 $_{HS_1D_AR}$	mg/kg	0.05	NONE	< 0.050	< 0.050	< 0.050
TPHCWG - Aromatic >EC10 - EC12 $_{EH_CU_1D_AR}$	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
TPHCWG - Aromatic >EC12 - EC16 $_{EH_CU_1D_AR}$	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0
TPHCWG - Aromatic >EC16 - EC21 $_{EH_CU_1D_AR}$	mg/kg	10	MCERTS	< 10	< 10	< 10
TPHCWG - Aromatic >EC21 - EC35 $_{EH_CU_1D_AR}$	mg/kg	10	MCERTS	< 10	< 10	< 10
TPHCWG - Aromatic >EC5 - EC35 $_{EH_CU+HS_1D_AR}$	mg/kg	10	NONE	< 10	< 10	< 10
VOCs						
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0
Benzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
Toluene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
p & m-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0
o-Xylene	µg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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Analytical Report Number : 24-025278
Project / Site name: York House

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
228704	WS01	None Supplied	0.75	Brown clay
228705	WS02	None Supplied	0.5	Brown clay and sand with gravel
228706	WS04	None Supplied	0.5	Brown clay and sand with gravel

Analytical Report Number : 24-025278
Project / Site name: York House

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in Soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques	In-house method based on HSG 248, 2021	A001B	D	ISO 17025
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate (Walkley Black Method)	In-house method	L009B	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight	In-house method based on British Standard Methods and MCERTS requirements.	L019B	D	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L038B	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES	In-house method	L038B	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Sulphate, water soluble, in soil (16hr extraction)	In-house method	L038B	D	MCERTS
Speciated PAHs and/or Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAH) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	L064B	D	MCERTS
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L076B/L088	D/W	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry	In-house method	L080	W	MCERTS
Free cyanide in soil	Determination of free cyanide by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	MCERTS
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080	W	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement	In-house method	L099	D	MCERTS
Asbestos Quant if Screen/ID positive	In-house method	In-house method		D	NONE

Analytical Report Number : 24-025278
Project / Site name: York House

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos types if id possitive	In-house method	In-house method		D	NONE

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total

Quality control parameter failure associated with individual result applies to calculated sum of individuals.
The result for sum should be interpreted with caution

End of Report

Constructionline
A UK GOVERNMENT CERTIFICATION SERVICE
QMS ISO 9001 : 2015 REGISTERED Cert No. 14123657
QMS ISO 14001 : 2015 REGISTERED Cert No. 14127804
QMS ISO 45001 : 2018 REGISTERED Cert No. 14130281
CIVATION APPROVED Registered Member
UKAS United Kingdom Accreditation Service

RGS Environmental Geotechnical Specialists
Rogers Geotechnical Services Ltd
Offices 1 & 2 Barncliffe Business Park, Near Bank, Shelley, Huddersfield, HD8 8LU
01484 604354 Company No. 5130864

< ENVIRONMENTAL > < GEOTECHNICAL >

Appendix 4

Soil Screening Value Comparison Sheet

Rogers Geotechnical Services: Soil Screening Values Comparison Sheet

Rogers Geotechnical Services Ltd: Soil Screening Value (SSV) Comparison Sheet

Job Number	C3900
Job Name	York House, Denby Dale
Date	21.06.2024
Client	Techwill Limited

A = WS Atkins PLC, Atrisk Soil Screening Values.
A+ = Values updated June 2017.
A* = Atrisk's SSV is lower than i2's detectable limit for this compound.
B = health criterion values, which are available from toxicological reviews published in the C4SL project methodology report.
C = Category 4 Screening Levels (C4SLs) based on 6% soil organic matter.
D = Value provided is based on Methyl Mercury. Should elemental mercury be observed or a source be known then a limit of 102 should be used.

KEY
- Exceeds SSV
- Exceeds 2017, Below 2015
- Below limit of detection (LOD)

Determinand	Units	Ref	LOD	Residential With Plant Uptake 1%		Sample Location	WS01	WS02	WS04							
				Atrisk 2015 (No Free Product	Atrisk 2017	Depth Top	0.75	0.50	0.50							
						Depth Base										
Cadmium	mg/kg	C	0.2		22.1		< 0.2	< 0.2	< 0.2							
Chromium (Hexavalent)	mg/kg	B/C	1.8	20.5	3.62		< 1.8	< 1.8	< 1.8							
Copper	mg/kg	A+	1.0		4730		7.00	13.00	21.00							
Mercury	mg/kg	A/D	0.3		8.81		< 0.3	< 0.3	< 0.3							
Nickel	mg/kg	A+	1.0		136		17.00	25.00	31.00							
Lead	mg/kg	C	1.0		200		7.50	11.00	31.00							
Zinc	mg/kg	A+	1.0		20000		33.00	55.00	85.00							
Vanadium	mg/kg	A+	1.0		136		21.00	26.00	27.00							
Arsenic	mg/kg	C	1.0		37		5.10	8.10	6.90							
Selenium	mg/kg	A	1.0		375		< 1.0	< 1.0	< 1.0							
Cyanide (Free)	mg/kg	A	1.0		34		< 1.0	< 1.0	< 1.0							
Total Phenols	mg/kg	A	1.0		267		< 1.0	< 1.0	< 1.0							
Naphthalene	mg/kg	A+	0.05	0	0.829		< 0.05	< 0.05	< 0.05							
Acenaphthylene	mg/kg		0.05				< 0.05	< 0.05	< 0.05							
Acenaphthene	mg/kg	A+	0.05	608	157		< 0.05	0.21	< 0.05							
Fluorene	mg/kg	A+	0.05	0	735		< 0.05	0.17	< 0.05							
Phenanthrene	mg/kg		0.05				0.08	1.30	0.06							
Anthracene	mg/kg	A+	0.05	0	10200		< 0.05	0.25	< 0.05							
Fluoranthene	mg/kg	A+	0.05		983		0.16	2.20	0.15							
Pyrene	mg/kg	A+	0.05		668		0.14	2.30	0.14							
Benzo[a]anthracene	mg/kg	A	0.05	4.52	1.71		0.07	0.96	0.07							
Chrysene	mg/kg	A	0.05	585	0.44		0.08	1.10	0.08							
Benzo[b]fluoranthene	mg/kg	A	0.05	7.72	1.22		0.10	1.30	0.12							
Benzo[k]fluoranthene	mg/kg	A	0.05	84.4	0.686		< 0.05	0.63	< 0.05							
Benzo[a]pyrene	mg/kg	B/C	0.05	4.95	1.51		0.09	1.30	0.11							
Indeno(1,2,3-c,d)Pyrene	mg/kg	A*	0.05	7.31	0.0614		0.06	0.68	0.07							
Dibenz(a,h)Anthracene	mg/kg	A	0.05	0.838	0.00393		< 0.05	0.17	< 0.05							
Benzo[g,h,i]perylene	mg/kg	A	0.05	96.2	0.0187		0.07	0.75	0.09							
Total Of 16 PAH's	mg/kg		0.8				0.84	13.50	0.88							
Aliphatic TPH >C5-C6	mg/kg	A+	0.02	0	42.7		< 0.020	< 0.020	< 0.020							
Aliphatic TPH >C6-C8	mg/kg	A+	0.02	0	99.3		< 0.020	< 0.020	< 0.020							
Aliphatic TPH >C8-C10	mg/kg	A+	0.05	0	13.9		< 0.050	< 0.050	< 0.050							
Aliphatic TPH >C10-C12	mg/kg	A+	1.0	81.7	49.9		< 1.0	< 1.0	< 1.0							
Aliphatic TPH >C12-C16	mg/kg	A+	2.0	385	20.9		< 2.0	< 2.0	< 2.0							
Aliphatic TPH >C16-C21	mg/kg	A+	8.0		210000		< 8.0	< 8.0	< 8.0							
Aliphatic TPH >C21-C35	mg/kg	A+	8.0		210000		< 8.0	< 8.0	< 8.0							
Aliphatic TPH >C35-C44	mg/kg		10.0													
Total Aliphatic Hydrocarbons	mg/kg		10.0													
Aromatic TPH >C5-C7	mg/kg	A+	0.01		0.137		< 0.010	< 0.010	< 0.010							
Aromatic TPH >C7-C8	mg/kg	A+	0.01	0	113		< 0.010	< 0.010	< 0.010							
Aromatic TPH >C8-C10	mg/kg	A+	0.05	0	20.5		< 0.050	< 0.050	< 0.050							

Rogers Geotechnical Services: Soil Screening Values Comparison Sheet

Rogers Geotechnical Services Ltd: Soil Screening Value (SSV) Comparison Sheet

Job Number	C3900
Job Name	York House, Denby Dale
Date	21.06.2024
Client	Techwill Limited

A = WS Atkins PLC, Atrisk Soil Screening Values.
A+ = Values updated June 2017.
A* = Atrisk's SSV is lower than i2's detectable limit for this compound.
B = health criterion values, which are available from toxicological reviews published in the C4SL project methodology report.
C = Category 4 Screening Levels (C4SLs) based on 6% soil organic matter.
D = Value provided is based on Methyl Mercury. Should elemental mercury be observed or a source be known then a limit of 102 should be used.

KEY
- Exceeds SSV
- Exceeds 2017, Below 2015
- Below limit of detection (LOD)

Determinand	Units	Ref	LOD	Residential With Plant Uptake 1%		Sample Location	WS01	WS02	WS04								
						Depth Top	0.75	0.50	0.50								
						Depth Base											
Aromatic TPH >C10-C12	mg/kg	A+	1.0		70		< 1.0	< 1.0	< 1.0								
Aromatic TPH >C12-C16	mg/kg	A+	2.0	165	155		< 2.0	< 2.0	< 2.0								
Aromatic TPH >C16-C21	mg/kg	A+	10.0		319		< 10	< 10	< 10								
Aromatic TPH >C21-C35	mg/kg	A+	10.0		1120		< 10	< 10	< 10								
Aromatic TPH >C35-C44	mg/kg		10.0														
Total Aromatic Hydrocarbons	mg/kg		10.0														
Total Petroleum Hydrocarbons	mg/kg		10.0														
pH			N/A				**7.60**	**8.20**	8.00								
Sulphate (2:1 Water Soluble) as SO4	g/l		0.00125				**0.01**	**0.02**	0.02								
ACM Type			N/A														
Asbestos Identification	%						Not detected	Not detected	Not detected								
ACM Detection Stage			N/A														
Moisture	%		0.01				15.00	13.00	11.00								
Soil Colour			N/A														
Other Material			N/A														
Soil Texture			N/A														
Sulphate (Total)	%		0.005														
Organic Matter	%		0.1				**0.50**	**0.30**	**0.50**								

Appendix 5

Fill Screening Values

Rogers Geotechnical Services Ltd.

Atkins ATRISK Soil Screening Values (SSVs) - Residential With Plant Uptake Landuse

Tox Data Report No.	Compound	Residential with Homegrown Produce Landuse (mg/kg)				Reference
	Metals	**SOM: 1%**		**SOM: 6%**		
3	Cadmium	22.1		22.1		C
4	Chromium VI	3.62	20.5	3.62	20.5	B/C
	Copper	4730		4790		A+
7	Mercury	8.81		15.80		A/D
8	Nickel	136		136		A+
	Lead	200		200		C
	Zinc	20000		20300		A+
	Vanadium	136		138		A+
	Semi and Non Metals					
1	Arsenic	37		37		C
10	Selenium	375		375		A
	Free Cyanide	34		34		A
9	Phenols (total)	267		1200		A
	Poly Aromatic Hydrocarbons	Free product	No free product	Free product	No free product	
20	Napthalene	0.829		12.2		A+
	Acenaphthene	157	608	2760		A+
	Fluorene	735		2610		A+
	Anthracene	10200		26200		A+
	Fluoranthene	983		2980		A+
	Pyrene	668		2120		A+
	Benzo(a)anthracene	1.71	4.52	8.54		A
2	Chrysene	0.44	585	2.64	927	A
2	Benzo(b)fluoranthene	1.22	7.72	7.29	9.86	A
2	Benzo(k)fluoranthene	0.686	84.4	4.12	100	A
2	Benzo(a)pyrene	1.51	4.95	0.998	5	B/C
2	Dibenzo(a,h)anthracene	0.00393	0.838	2.05	4.95	A*
2	Indeno(1,2,3-cd)pyrene	0.0614	7.31	0.368	9.75	A
2	Benzo(g,h,i)perylene	0.0187	96.2	0.112	103	A
	Petroleum Hydrocarbons					
	Aliphatic C5-C6	42.7		369		A+
	Aliphatic C6-C8	99.3		768	1240	A+
	Aliphatic C8-C10	13.9		204		A+
	Aliphatic C10-C12	49.9	81.7	297	1180	A+
	Aliphatic C12-C16	20.9	385	125	4130	A+
	Aliphatic C16-C21	210000		210100		A+
	Aliphatic C21-C35	210000		210100		A+
	Aromatic C5-C7 (Benzene)	0.137		0.871		A+
	Aromatic C7-C8 (Toluene)	113		780		A+
	Aromatic C8-C10	20.5		232		A+
	Aromatic C10-C12	70		468		A+
	Aromatic C12-C16	155	165	830		A+
	Aromatic C16-C21	319		1040		A+
	Aromatic C21-C35	1120		1710		A+

A+ = Values update June 2017.

A* Atrisk's SSV is lower than Chemtest's detectable limit for this compound.

B = Health Criterion Values (available from toxicological reviews published in the C4SL project methodology report).

C = Catergory 4 Screening Levels (C4SLs).

D = SSV provided is for Methyl Mercury.